Hydrogeology and Water Supply Wells at Gila Cliff Dwellings National Monument

Introduction

In July 1962, the USGS conducted a reconnaissance investigation of the geology and groundwater resources in the vicinity of Gila Cliff Dwellings National Monument to determine if an adequate supply of potable water could be found to support development of administrative and visitor facilities for the park. In 1964, test drilling was conducted and a suitable water supply well was constructed along the Middle Fork of the Gila River. In 1983, the "Woody's Corral Well" was constructed on state land along the West Fork of the Gila River. In the early 1990s this became the main water supply well for the park. In 2004, the well failed and was replaced with a new well located about 20 feet from the original Woody's Corral Well.

During the process of evaluating the failing well and constructing a new well in 2004, there was some confusion about which construction records were associated with each well in the field. There was also some discussion regarding the potential for alternative well locations and alternative groundwater sources. This report is being written to clear up these matters for future park managers who will likely be faced with similar questions in 20-30 years.

Hydrogeology

The geologic formations exposed at, and underlying, Gila Cliff Dwellings National Monument are from oldest to youngest; 1) rhyolite tuff, 2) basalt, 3) Gila Conglomerate, and 4) alluvium. The rhyolite tuff is a volcanic rock deposited during a pyroclastic volcanic eruption. The rhyolite is a very dense rock and not likely to be a source of groundwater. The basalt was deposited as a lava flow during a less explosive volcanic eruption. The basalt should contain groundwater because it is generally vesicular and

Larry Martin
NPS-Water Resources Division
February 4, 2005

broken by a large number of small joints and fractures. The Gila Conglomerate is a sedimentary rock comprised of sand, clay, pebbles, and boulders that were eroded from the surrounding mountains, transported and deposited by streams, and subsequently cemented together. The Gila Conglomerate is not a good aquifer because of the poor sorting and strong cementation; leaving few pore spaces for groundwater to flow through. The unconsolidated alluvial deposits in the river valleys range in size from clay and silt to boulders. The alluvium contains and transmits water, and is the only reliable source of groundwater in the area (Trauger, 1963). The Headquarters and Woody's Corral Wells both obtain water from the alluvium.

Hydrogeologic conditions are not as simple as described in the preceding paragraph, but this is only meant to be a general description. Test drilling in 1964 showed that although there is water in the basalt lava flows, the quality is poor. Thus the alluvium is the only reliable and practicable groundwater source in the area.

1964 Test Drilling

Two test wells were constructed in July & August of 1964. Both wells were located south of the Middle Fork and north of the visitor's center. The first well was drilled to a depth of 600 feet to test the water supply from the basalt lava flows. The well produced about 5 gpm of poor quality water. Total dissolved solids concentration was about 2500 ppm with 1600 ppm sulfate and 8 ppm fluoride, making it unpotable (West, 1964).

The second test well was constructed 600 feet west of the first well and 180 feet southeast of the river. This well was drilled through the alluvium and a few feet into the underlying Gila Conglomerate. The well was completed with 6-inch casing to a depth of 37 feet. The bottom 10 feet of casing was perforated. The well produced 15 gpm during a 7-hour test which caused the water level to be drawn down from the static level of 10 feet below ground surface to 21 feet below ground surface. The water quality was good except for fluoride which was slightly higher than Public Health Standards. This well became

known as the Headquarters Well and was the primary water supply for the park for many years.

Existing Wells (2004)

The Headquarters Well (GSF-721) was constructed by the National Park Service in 1964 under the supervision of the USGS. The well is 37 feet deep and obtains water from the alluvium along the Middle Fork. Currently (2004) the well has fallen into disrepair and is not used. Plans are to repair it in 2005 by installing a new pump, cleaning up the plumbing, and installing a valve to isolate the well from the distribution system. The well will be maintained as an emergency backup supply. Permanent use of the well will be discouraged because of the high fluoride concentration. Power for operating the pump will be supplied by a generator; there will be no permanent electrical supply.

Several exploratory holes were drilled in 1965 (J.R. Caulkins, pers. comm.). One of these test holes was improved in 1983 and became Woody's Corral Well (GSF-2278). The well was drilled to a depth of 52 feet and was completed with 10 feet of well screen from 42-52 feet. The well produced 25 gpm. It was acquired by the National Park Service in 1993 as a supplementary water source and the permit number was changed to GSF-721-S. Eventually this became the sole source of water for the park as the Headquarters Well fell into disrepair and was no longer used. In the summer of 2004, this well failed and no longer produced a sustainable water supply. A new well was drilled approximately 20 feet from the old well. The new well is 100 feet deep and was completed with PVC casing and that was perforated from 25-80 feet below ground surface. The new well was drilled through alluvium to a depth of 40 feet and then conglomerate from 40-100 feet.

Abandoned Wells

There was a well located in the valley of the West Fork of the Gila River near the mouth of Cliff Dweller Canyon. It was constructed in October of 1965. This well was

originally designated GSF-896-A, but was renamed GSF-721-S2 when it was included as a second supplementary source of water for the park. At one time this well, the old Woody's Corral Well and the Headquarters Well were all connected to the water supply and distribution system for the park. The well is no longer used and is not connected to the supply and distribution system. It has been plugged with concrete.

The Scorpion Corral Well was constructed in 1967. It produced 11 gpm and provided water for the Scorpion Campground and the visitor contact station at the entrance to Cliff Dwellers Canyon. The well was plugged and abandoned in the late 1990's when a new water system was installed (J.R. Caulkins, pers.comm.).

Non-NPS Wells

There are two non-NPS wells in the immediate area. Both are located within the valley of the Gila River and are approximately ½ and 1 mile southeast of the Woody's Corral Well.

In 1983, a test well (GSF-2279) was constructed on land owned by the New Mexico Department of Game and Fish about ½ mile southeast of the Woody's Corral Well. The well was 50 feet deep and the depth to water was 12 feet. The current condition of the well is unknown.

The New Mexico State Game Commission constructed a well (GSF-2417) in 1985 about 1 mile southeast of the Woody's Corral Well. It is 330 feet deep and supplies domestic water for residences. This well replaces a shallow alluvial well at the same location.

Water Quality

Water quality in the alluvium is generally very good. Results of analyses for samples from the Headquarters Well and Woody's Corral Well are tabulated in the following table.

Where an alluvial well is located a short distance downstream of a hot spring, the water quality from the well may be affected by discharge of highly mineralized thermal water from the springs. Studies of water quality in the river and adjacent alluvial wells show that inflow from hot springs raises the fluoride and silica content and the temperature of water from wells located downstream of the springs (Fitzsimmons and Lochman-Balk, 1965). The Headquarters Well, along the Middle Fork of the Gila River, is located about ½ mile downstream of Boundary Hot Spring. Water from the well has a fluoride content of about 3 ppm. Water from the Headquarters Well is slightly more mineralized than water from the Woody's Corral Well, possibly due to the influence of water discharging at Boundary Hot Spring a short distance upstream from the Headquarters Well.

Alluvial water quality at Gila Cliff Dwellings National Monument		
	Headquarters Well	Woody's Corral Well
	August 8, 1964	August 9, 2003
TDS	210	174
Sp. Cond.	304	175
Hardness	69	73.7
Ca	22	22.8
Mg	3.4	4.1
Na	38	10.9
K	2.3	<5
HCO_3	116	101.3
CO_3	0	0
SO_4	25	<10
Cl	18	<10
F	3.0	0.73 (7/30/2002)
NO_3	0.1	<0.1
SiO_2	44	---
Fe	0.07	<0.1

Water Rights

The park has a water right for ten acre-feet per year with a priority date of September 8, 1964. The original source of water for this water right was Well No. GSF-721 (the Headquarters Well). Woody's Corral Well (GSF-721S) is a supplemental source for this

water right. Water can be used in any combination from the two wells as long as the total amount pumped in a year is less than 10 acre-feet. The designated uses of the water are domestic, maintenance, recreation, and irrigation of two acres of land. Ten acre-feet is 3.26 million gallons.

Summary

Deep bedrock wells in the area are likely to produce poor quality water. The alluvium along the West Fork of the Gila River, upstream of the confluence with the Middle Fork, is the best source of potable water in the area. Groundwater in the alluvium along the Middle Fork will be more mineralized and probably contain fluoride exceeding public health standards due to infiltration of water from hot springs a short distance upstream from the park.

References

Caulkins, J.R., 2005, personal communication, Civil Engineer for the Gila National Forest, Silver City, New Mexico

Fitzsimmons, J.P. and C. Lochman-Balk (co-editors), 1965, Guidebook of Southwestern New Mexico II. New Mexico Geological Society

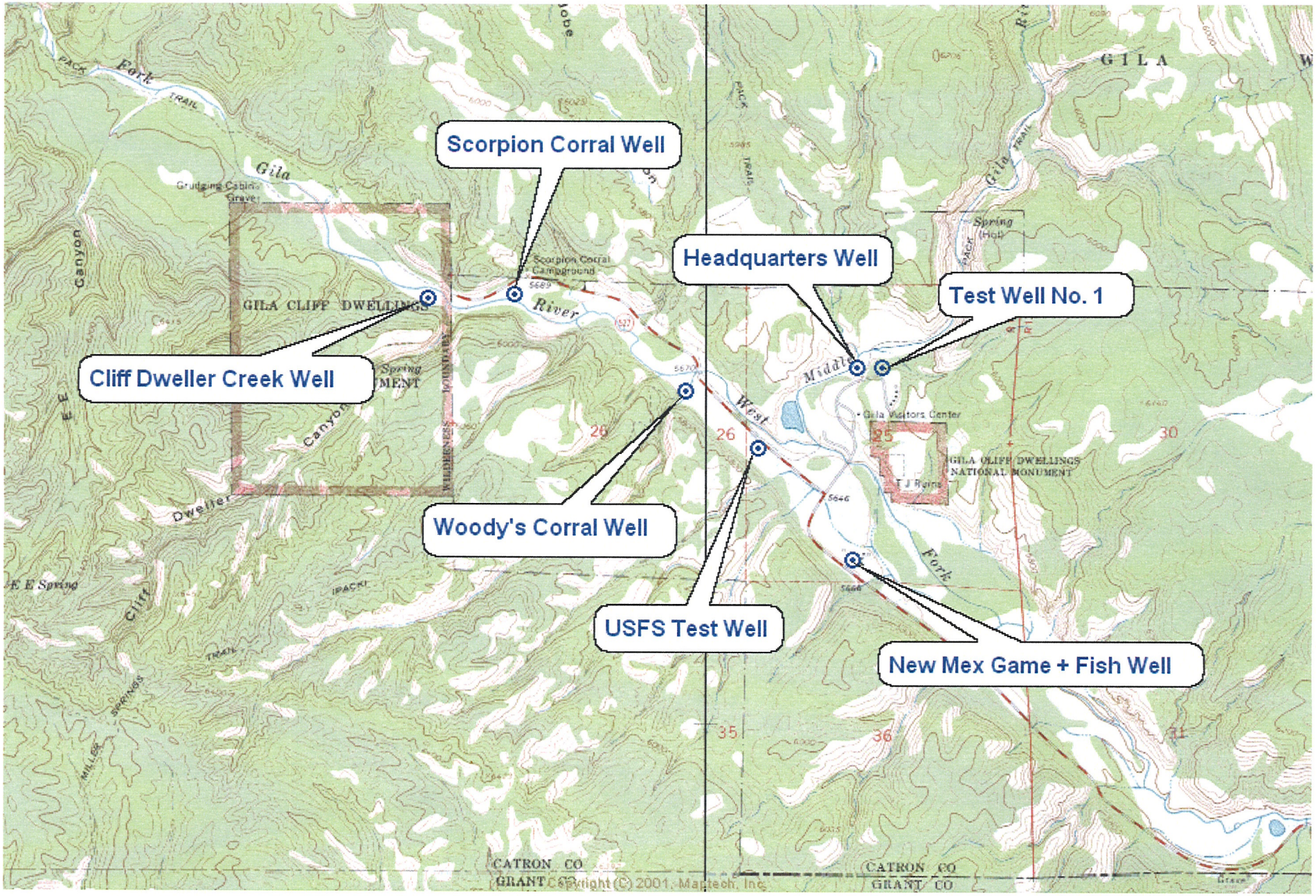
Trauger, F.D., 1963, Geology and Availability of Ground Water in the Vicinity of Gila Cliff Dwellings National Monument, Catron County, New Mexico. USGS Open-File Report 63-122, 24 pp.

West, Sam W., 1964, letter report from USGS Albuquerque Office to National park Service Regional Director in Santa Fe, September 2, 1964, 8 pp.

Well Name	Permit Number	Location*	Year Drilled	Depth	Aquifer	Use	Remarks
Headquarters Well	GSF-721	12.14.25.141	1964	37'	Alluvium	Backup supply for park	
Woody's Corral Well	GSF-2278 GSF-721-S	12.14.26.244	1983 2004	52' 100'	Alluvium & upper part of Gila Conglomerate	Main supply for park	Replacement well constructed in 2004
Cliff Dweller Creek Well	GSF-721-S2	12.14.27.221	1965	???	Alluvium	Abandoned	
Scorpion Corral Well	---	12.14.26.112	1967	???	Alluvium	Abandoned	
Test Well No. 1	---	12.14.25.142	1964	600'	Basalt Lava Flow	Abandoned	Yielded approx. 5 gpm of poor quality water
USFS Test Well	GSF-2279	12.14.25.311	1983	50'	Alluvium	???	
New Mexico Game & Fish	GSF-2417	12.14.25.344	1985	330	???	Supply well for residences	Replacement for a shallow alluvial well at same location

*The first number in the location is the Township, the second number is the Range, the third number is the Section, the fourth number provides the ¼,¼,¼ of the section from largest to smallest with 1=NW, 2=NE, 3=SW, 4=SE. A well numbered 12.14.25.141 is located in township 12S, Range 14W, Section 25, in the NW¼, SE¼, NE¼.

General information for wells in the vicinity of Gila Cliff Dwellings National Monument



Wells in the vicinity of Gila Cliff Dwellings National Monument